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Readiness Spares Package Non-Optimized (NOP) Item Computation Analysis

AFLMA FINAL REPORT LS199601000
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13. ABSTRACT (Maximum 200 Words)

The objective of this study is to provide Air Force standard NOP item computations to correctly and consistently determine RSP NOP requirements. Based on the sample RSP computations, four basic conclusions were reached: 1. The cost-based marginal analysis approach used in REALM/ASM provides more aircraft availability at less cost. 2. D087 demand rate whole kit computations in REALM are feasible. 3. The kit computations are very sensitive to demand data. Inaccuracies demand data or demand rate conversion assumptions can have significant impact on the breadth and depth of the computed kit. 4. RSPs with AFLMA formula computed NOP items provide similar or greater aircraft availability for comparable cost RSPs with PACAF spreadsheet computed NOP items, but both methods cost more and yield lower AA than DMAS/ASM computed kits. Human monitoring and intervention continues to be necessary for RSP NOP item demand data and requirements calculations. Our recommendation is to compute entire RSPs (including all NOP items) in REALM with close monitoring by MAJCOM representatives.

14. SUBJECT TERMS

Non-optimized, NOP, Readiness Spares Package, RSP, Dyna-METRIC Microcomputer Analysis System, DMAS, Requirements/Execution Availability Logistics Module, REALM, Weapon System Management Info. System, WSMIS, Sustainability Assesment Module, SAM, DSO, D087

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EXECUTIVE SUMMARY

BACKGROUND PROBLEM STATEMENT:

Readiness Spares Package (RSP) authorizations for Non-optimized (NOP) items are not flying hour based and must be computed using other measurements (rounds fired, sorties, cycles, etc.). Currently, there is no clear methodology for computing RSP authorization levels for NOP assets. During the 4-8 Nov 96 Air Force Supply Wartime Policy Working Group (AFSWPWG) the Air Force Logistics Management Agency (AFLMA) was asked to assist in evaluating alternative ways of computing the breadth and depth of NOP assets placed in Readiness Spares Packages.

OBJECTIVE:

Provide Air Force standard NOP item computations to correctly and consistently determine RSP NOP requirements.

ANALYSIS/RESULTS:

Our analysis shows that the cost-based marginal analysis approach used in DMAS/ASM provides the best aircraft availability at the least cost when computing NOP items. The present NOP requirements formulas (built into an Excel Spreadsheet by HQ PACAF) have limitations which can cause an inaccurate portrayal of requirements. The formula presented at the Jul 97 AFSWPWG by the AFLMA incorporates many of the factors missing from the PACAF generated spreadsheet, such as QPA, cannibalization, repair capability, safety level, and the Direct Support Objective (DSO). The AFLMA formula produces greater expected aircraft availability rates than the PACAF spreadsheet formulas. The AFLMA formula, however, is more data intensive and it is difficult to compute a proper F-factor for the safety level size. It also does not include the important element of marginal analysis which evaluates the kit items against each other using cost and demand factors. This can result in larger kits and higher kit costs when using the AFLMA formula versus DMAS/ASM.

ASSUMPTIONS AND CONSTRAINTS:

The scope of this study is limited to examining one unit specific readiness spares package for seven different weapons systems. The computed RSPs for two of these weapon systems (F-16 and C-130) will be examined in detail. NOP Reason Code S (sortie related failures) and R (rounds fired related failures) are examined in this study. There is currently little or no data collected on other NOP Reason Coded items, such as T (run time/cycles) items. The numbers and associated costs of NOP items not coded as S or R were negligible in the RSPs examined. Although there are additional NOP issues which need to be addressed (such as the identification and coding of NOP items), this study assumes current NOP categories and item codings are valid

i

and correct. The study results are limited by the number of weapon systems, units, and scenarios examined. This study examines the methods for computing RSPs, not the demand rates used to calculate them.

CONCLUSIONS:

1. Using the current D087 demand rates, whole kit computations in REALM are feasible.
    *   Non-NOP items (AAA) are not displaced by the NOP items when they are computed together using D087 demand rates.
    *   The overall size of the computed RSP (total parts) does not significantly increase when NOP items are included in the REALM kit computation.
2. The kit computations are sensitive to demand data. Inaccuracies in D041 demand data or demand rate conversion assumptions can have significant impact on the breadth and depth of the computed kit.
3. The cost-based marginal analysis approach used in REALM/ASM provides more aircraft availability at less cost.
    *   RSPs with AFLMA formula computed NOP items provide similar or greater aircraft availability for comparable cost RSPs with PACAF spreadsheet computed NOP items, but both methods cost more and yield lower AA than DMAS/ASM computed kits.
4. Obtaining proper demand data for RSP NOP item computations continues to be an issue and is not resolved in this study. Human monitoring and intervention continues to be necessary for RSP NOP item demand data and requirements calculations. Initial NOP quantities or flying hour demand rates still must be provided by the MAJCOM.

RECOMMENDATIONS:

1. Compute entire RSPs (including all NOP items) in REALM (D087).
    *   Review NOP demand rates before REALM/ASM RSP computations to ensure accuracy. MAJCOM representatives should collect and bring appropriate NOP demand data to the annual RSP reviews to fill data gaps in D087 data.
2. Compare the REALM/ASM computed RSP NOP quantities to the previously maintained NOP quantities to ensure inaccurate data has not corrupted the computations.
    *   Previous RSP NOP quantities should be file maintained as a fallback for unreasonable REALM computed quantities. (This is only an interim measure to be used until computation methods and results are verified as appropriate.)
    *   All NOP quantity changes from year to year should be reviewed

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

TABLES

FIGURES

CHAPTER 1

INTRODUCTION

<u>BACKGROUND</u>

Readiness Spares Package (RSP) authorizations for Non-optimized (NOP) items are not flying hour based or do not have sufficient peacetime flying hour experience to properly forecast wartime demand. These items must be computed using other measurements. NOP items fail based on factors such as rounds fired, sorties, and cycles. The calculation of RSP NOP quantities are currently done by MAJCOM Weapon System Managers (WSMs) using a spreadsheet or through negotiation, versus on-line in the Requirements/Execution Availability Logistics Module (REALM) for other RSP items. Many NOP assets have low peacetime demand rates, and, as a result, there is a perception these assets increase overall RSP requirements while returning marginal capability.

Currently, there is a lack of clear guidance for computing RSP authorization levels for NOP assets. Air Force Manual 23-110 (AFI 67-1), Volume 1, Part One, Chapter 14 describes basic procedures for determining RSP requirements, but falls short of showing how to actually compute NOP quantities. AFLMA Project LS930082 addressed the process of building and fielding RSPs, and contains the basic NOP equations analyzed in this study.

Basically, AFLMA Project LS930082 translated the words of Chapter 14 into equations; however, these equations may not yield results which fully represent the needs of deployed units. These formulas consider peacetime demands, but do not include elements such as repair, surge, or a safety level. Currently used (PACAF developed) spreadsheets for computing NOP quantities are based on these formulas. Computations for wheel and tire NOP items are calculated separately from the other sortie related failure items using different formulas.

As part of this report, a new formula was developed by the AFLMA for sortie and gun related failures. The new formula incorporates repair capability, surge sortie rates, interim sortie rates, a safety level, and a modified cannibalization calculation to yield more representative requirements. This formula was presented to the Air Force Supply Wartime Policy Working Group in Jul 97, and was accepted as an alternative to calculate NOP requirements (see appendix A).

This study is partially in response to Air Force Audit Agency (AFAA) Report of Audit Project 9601002, which was briefed at the Air Force Supply Wartime Policy Working Group, November 1996. Audit 9601002 reviewed manually computed RSP requirements and made recommendations on the requirements determination process for RSPs.

PROBLEM STATEMENT

How should RSP NOP quantities be calculated? Standard Air Force NOP computations are needed to correctly and consistently determine RSP NOP requirements.

STUDY OBJECTIVES

The objectives of this study are to:
1) Evaluate current equations used to compute RSP authorizations for NOP assets.
2) Determine appropriate RSP NOP computations.
3) Determine the impact of including NOP item requirements computations in REALM.
4) Determine the costs of computing NOP item requirements using:
   a. Formulas built into a spreadsheet by HQ PACAF
   b. The AFLMA presented formula
   c. REALM/ASM

CHAPTER 2

RESEARCH, DEVELOPMENT, AND DISCUSSION

APPROACH

This study will evaluate three NOP requirement computation options:

1. <u>PACAF</u> - Maintain the current NOP requirements computation methodology of using the Excel Spreadsheet developed by HQ PACAF.
2. <u>AFLMA</u> - Use AFLMA proposed formulas built into an Excel Spreadsheet to compute NOP kit requirements.
3. <u>D087</u> - Compute NOP items in REALM/ASM as part of the whole kit.

NOP requirement computations are currently accomplished off-line by WSMs. Using REALM for these calculations would save manpower, add consistency to the calculations, and employ marginal analysis to determine the best RSP configuration. Testing the impact of using REALM for NOP requirements computations is a primary goal of this analysis.

SCOPE

The scope of this study is limited to examining one unit specific readiness spares package for seven different weapons systems. The computed RSPs for two of these weapon systems (F-16 and C-130) will be examined in detail. NOP Reason Code S (sortie related failures) and R (rounds fired related failures) are examined in this study. There is currently little or no data collected on other NOP Reason Coded items, such as T (run time/cycles) items. The numbers and associated costs of NOP items not coded as S or R were negligible in the RSPs examined.

LIMITATIONS/ASSUMPTIONS

Although there are additional NOP issues which need to be addressed (such as the identification and coding of NOP items), this study assumes current NOP categories and item codings are valid and correct. The study results are limited by the number of weapon systems, units, and scenarios examined. This study examines the methods for computing RSPs, not the demand rates used to calculate them.

3

OPTIONS

OPTION 1 – *Currently Used NOP Requirements Formulas (PACAF Spreadsheet)*

The currently used NOP requirements formulas built into an Excel Spreadsheet by HQ PACAF (see Appendix B) have limitations, which inaccurately portray requirements. None of the four separate formulas use marginal analysis (trade-offs with other components) in their computations, nor do they use safety levels to ensure a determined level of support will be met. In addition, the formulas have the following limitations:

GUN NOP FORMULA
- Currently handles DSO incorrectly (should be 1 – DSO or number of grounded jets)
- Cannibalizations don't account for QPA
- No repair capability considered (assumes 100% NRTS)

SORTIE NOP FORMULA
- QPA should either be placed in the numerator or taken out of the denominator (QPA must cancel out or be eliminated from the equation)
- Currently handles DSO incorrectly (should be 1 – DSO or number of grounded jets)
- Cannibalizations don't take QPA into account
- No repair capability considered (assumes 100% NRTS)

ADDITIONAL SORTIE-BASED NOP COMPUTATION FORMULAS
- TIRE FORMULA
    - Cannibalizations not considered
- WHEEL FORMULA
    - Cannibalizations not considered
    - No repair capability considered (assumes 100% NRTS)

OPTION 2 - *AFLMA Proposed Formulas*

The AFLMA formula (see Appendix A) incorporates many of the factors the PACAF generated spreadsheet does not adequately address, such as QPA, cannibalization (cann.), repair capability, safety level, and DSO. It does not, however, include the important element of marginal analysis which evaluates the kit items against each other using cost and demand factors. This can result in a larger than necessary kit size and higher costs (see results below).

Surge and post-surge (interim) sortie rates are both considered by the AFLMA formula. Quantities for items which are NOT feasible cann. items are computed for the surge and interim sortie periods (the entire kit period). Quantities for items which are feasible cann. items are calculated only for the period before repair is expected to be operational, to include expected repair cycle time. The variable F-factor, associated with the AFLMA formula computation results, is a multiplier of the standard deviation of the computed requirement. This F-factor, which is explained in the AFLMA Formula Computations section later in this chapter, determines the quantity of safety level to be included. The safety level is determined by multiplying the square-root of the computed demands by the F-factor. The C-factor for

cannibalization is used as a flag to identify feasible cann. items. If the item is not feasible to cann., C=0 is used to eliminate the cannibalization portion of the equation. It the item is a feasible cann. item, C=1 is used.

OPTION 3 - *REALM/ASM Computations*

REALM/ASM whole kit computations were examined for the NOP items. D087 Sustainability Assessment Module (SAM) "backed-in" demand rates were used for NOP items for the REALM whole-kit computations. The backed-in demands rates are generated in the SAM by taking the inputted NOP quantity and "backing" into a flying hours demand rate.

There are two primary options when providing demand data for REALM RSP NOP computations. The data can be provided as demands per flying hour or non-flying hour demands. Demand data not provided as demands per flying hour must be converted to flying hour based failures before REALM can compute the kit. The first step in examining the incorporation of NOP items into REALM using D041 or MAJCOM provided demand rates was developing **conversion formulas** to change the non-flying hour based demand items into flying hour demands. Assets which have requirements computed in REALM fail based on the number of flying hours, but NOP items, by definition, fail related to other factors. NOP items fail based on things such as the number of sorties flown or the number of rounds fired. This difference can be resolved by converting NOP item demands into flying hour demands using some simple equations. The two primary NOP Reason Coded items of S (sortie related failures), and R (rounds-fired related failures) can be converted to flying hour demands using the formulas in Figure 1 below. The bolded items in the formula represent data currently used to compute NOP quantities, and the other data can be obtained from either the War Mobilization Plan (WMP-5) or HQ USAF/ILM

$$S: \quad \frac{\text{Demands}}{\text{Flying Hr.}} = \frac{\textbf{Demands}}{\textbf{Sortie}} \times \frac{\text{Sorties}}{\text{Flying Hr.}}$$

$$R: \quad \frac{\text{Demands}}{\text{Flying Hr.}} = \frac{\text{Rounds}}{\text{Sortie}} \times \frac{\text{Sorties}}{\text{Flying Hr.}} \times \frac{\textbf{Demands}}{\textbf{Round}}$$

Figure 1. Demand Rate Conversion Formulas

As we show later, the computation is sensitive to the failure rates and the factors used to convert failure rates into demands per flying hour. For this part of the study we use current D087 backed-into demand rates in our computations.

RESULTS

In order to determine the impact of incorporating the computation of NOP items in REALM, some sample RSP computations were done to show the impact. The Headquarters Air Force Materiel Command (HQ AFMC) Weapon System Management Information System (WSMIS) –

Sustainability Assessment Module (SAM) Office provided unit specific Dyna-METRIC Microcomputer Analysis System (DMAS) files for each of the following weapon systems:

- F16C
- F15E
- F15C
- A10A
- C130
- E-3
- B52H

The Logistics Management Institute (LMI) provided D041demand rates and Use Codes for all of the NOP and adjusted items that were available. This data was used as a small cross-section of the Air Force inventory. Because of the amount of data involved and the desire to look at as many different weapon systems as possible, only one kit per weapon system was used. This was not considered a limitation because the goal was to find general trends/impacts, not specific kit changes. The scenario used in this analysis is notional and was held constant across each of the three alternative computations.

Two primary kit computations were done:

a. First, a baseline computation was made that computed the kit requirements using only the currently computed (AAA) items. This was done because the notional scenario computed requirements won't match the currently authorized kit requirements. D087 file maintained rates were used.

b. Second, a kit was computed using all items (non-optimized-NOP, computed-AAA, and adjusted-ADJ) in the current "kit" range. D087 backed-in demand rates were used for the NOP/ADJ items, and D087 file maintained rates were used for the AAA items, as in the first computation. The number of adjusted items did not significantly impact the kit computation (F-16 - 1 percent; C-130 - 5 percent) in terms of the number of line-items or overall kit cost.

The F-16 and C-130 kit computations will be examined in detail to show the specific changes and their associated costs using the three methods/options (PACAF spreadsheet formulas, AFLMA formula, and REALM {D087}). Appendix D shows the computation results for the other five weapon systems and Appendix E shows the results of D041 demand rate sample kit computations. The D041 demand rate computations will be discussed in the Sensitivity Analysis Section later in this chapter.

F-16

Table I below shows a break-out of the items in each kit and the associated costs of those items. The first column of each item type (AAA, NOP, ADJ) shows the number of NSNs (range) and total items (depth) resulting from each computation method. The first row (D087-AAA) represents the DMAS computation of AAA items only, utilizing D087 demand rates. Note both the PACAF and LMA kits incorporate these same DMAS AAA computed items. The DMAS whole-kit computation (D087-ALL) resulted in a kit with nearly identical AAA items. The same NSNs were included with only one additional part added to the kit. Since the first row represents the baseline DMAS computation of AAA items only, no NOP items were included. No adjusted items were included by any of the computation methods.

F-16	AAA		NOP		ADJ		TOTAL	
	NSN's/Items	Cost	NSN's/Items	Cost	NSN's/Items	Cost	NSN's/Items	Cost
D087-AAA	36/91	$3.6M	n/a	n/a	n/a	n/a	36/91	$3.6M
PACAF	36/91	$3.6M	14/32	$186K	0	0	50/123	$3.8M
LMA	36/91	$3.6M	11/57	$368K	0	0	47/148	$4.0M
DO87-ALL	36/92	$3.7M	9/38	$178K	0	0	45/130	$3.9M

Table I. F-16 Kit Composition By Computation Method

The primary kit differences are in the specific NOP items included by the different methods. The PACAF kit computation is used as a baseline for comparison, since it is currently the typical method used.

F-16 PACAF TO DMAS WHOLE-KIT NOP COMPARISON
Of the 14 PACAF NOP NSNs that had a positive level, 10 went to 0 using DMAS to compute the whole kit. Of the 27 NOP NSNs which had a zero level using the PACAF formulas, 5 gained a level using DMAS. Of the total 41 NOP NSNs for possible inclusion in the kit, a total of 22 NSNs remained unchanged with a level of zero for both computation methods; 10 NSNs decreased in quantity using DMAS; and 9 NSNs increased in quantity using DMAS. The difference in the cost of NOP items for the two methods was small with an $8K decrease in cost using DMAS to compute the NOP items. Note the depth and cost of the computed items went up (by 1). This is consistent with ASM logic. As NSNs with a demand level are added to the kit, the number of computed items per NSN tend to increase.

F-16 PACAF TO LMA (F=6) NOP COMPARISON
Of the 14 PACAF formula computed NOP NSNs that had a positive level, 10 went to 0 using the LMA NOP formula. Of the 27 PACAF formula computed NOP NSNs that had a zero level, 7 gained a level using the LMA NOP formula. Of the total 41 NOP NSNs for possible inclusion in the kit, a total of 20 NSNs remained unchanged with a level of zero for both computation methods; 10 NSNs decreased in quantity using the LMA formula; and 11 NSNs increased in quantity using the LMA formula. The cost of the NOP items computed using the LMA formula was nearly double the cost of the PACAF computed or DMAS computed NOP items, as shown in Figure 3 below. This high cost is due to the high F-factor used to meet the required DSO. The only variable in the AFLMA formula is the F-factor, or number of standard deviations used to compute the safety level. As the F-Factor increases, the safety level and depth (the number of NOP items) and the associated costs increase. The F-factor will be discussed more at the end of this section.
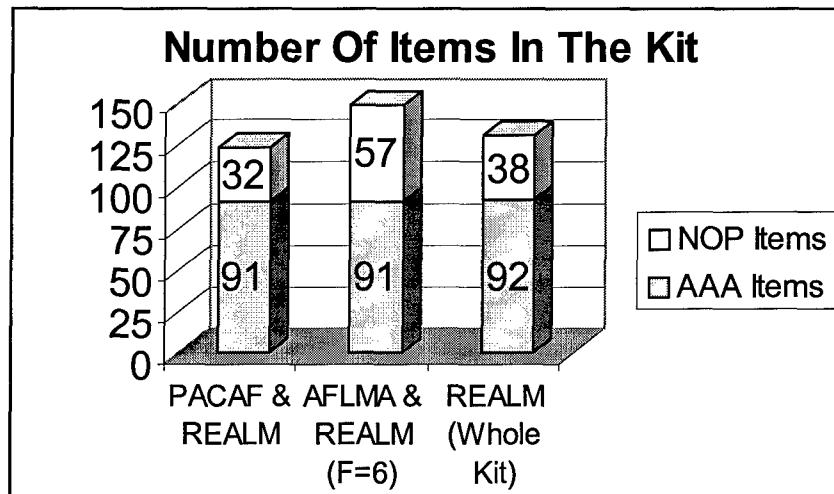
Number Of Items In The Kit

Figure 2. F-16 Kit Compositions

Kit Costs in Millions Of Dollars
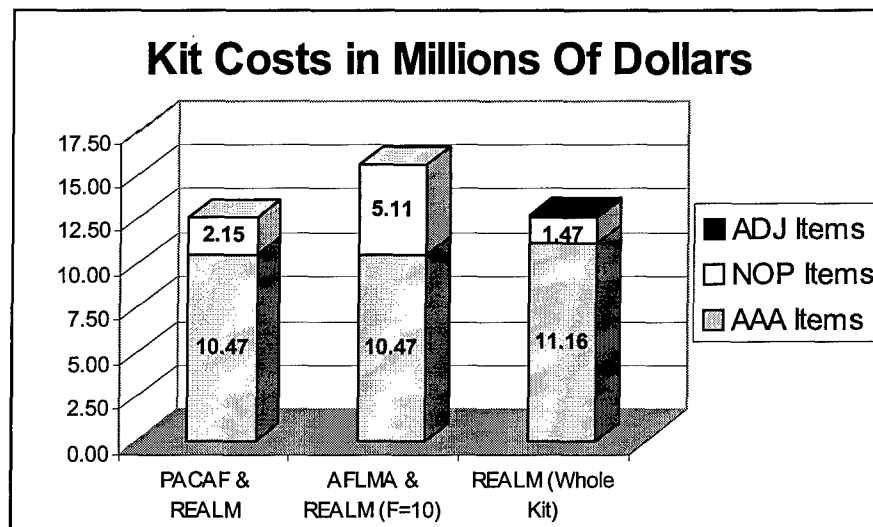
Figure 3. F-16 Kit Costs

C-130

Table II below shows a break-out of the items in each kit and the associated costs of those items for the C-130. As with the F-16 data, the first column of each item type (AAA, NOP, ADJ) shows the number of NSNs and total items resulting from each computation method. The first row represents the DMAS computation of AAA items only, utilizing D087 demand rates. Again, both the PACAF and LMA kits incorporate these same DMAS AAA computed items. The DMAS whole-kit computation (D087-ALL) again computed a kit with nearly identical AAA items as the PACAF and LMA computed kits. A total of 3 AAA NSNs and 36 total AAA parts were added for an added cost of $690K (a 6.6% cost increase). No NSNs were excluded. Since the first row represents the baseline DMAS computation of AAA items only, no NOP items were included.

8

Although no adjusted items were included in the PACAF and LMA computations, a very small number were included in the DMAS whole-kit computation. However, the quantity and cost of the adjusted items were insignificant compared to the overall kit size and cost.

C-130	AAA		NOP		ADJ		TOTAL	
	NSN's/Items	Cost	NSN's/Items	Cost	NSN's/Items	Cost	NSN's/Items	Cost
D087-AAA	121/480	$10.5M	n/a	n/a	n/a	n/a	121/480	$10.5M
PACAF	121/480	$10.5M	30/73	$2.2M	0	0	154/553	$12.6M
LMA	121/480	$10.5M	41/226	$5.1M	0	0	165/706	$15.6M
DO87-ALL	124/516	$11.2M	41/167	$1.5M	3/4	$62K	168/687	$12.7M

Table II. C-130 Kit Composition By Computation Method

As with the F-16 computations, the primary kit difference for the C-130 is the NOP item mixture included by the different methods. The PACAF formula computed kit is used as a baseline for comparing the C-130 kit computations also.

C-130 PACAF TO DMAS WHOLE-KIT NOP COMPARISON
Of the 30 PACAF NOP NSNs that had a positive level, 4 went to 0 using DMAS to compute the whole kit. Of the 45 NOP NSNs which had a zero level using the PACAF formulas, 15 gained a level using DMAS. Of the total 75 NOP NSNs for possible inclusion in the kit, A total of 33 NSNs remained unchanged with 30 of the 33 maintaining a level of zero for both computation methods; 4 NSNs decreased in quantity using DMAS; and 38 NSNs increased in quantity using DMAS. The difference in the cost of NOP items for the two methods was a $680K decrease in cost using DMAS to compute the NOP items.

C-130 PACAF TO LMA (F=10) NOP COMPARISON
Of the 30 PACAF formula computed NOP NSNs that had a positive level, 5 went to 0 using the LMA NOP formula. Of the 45 PACAF formula computed NOP NSNs that had a zero level, 16 gained a level using the LMA NOP formula. Of the total 75 NOP NSNs for possible inclusion in the kit, A total of 32 NSNs remained unchanged with 29 of the 33 maintaining a level of zero for both computation methods; 5 NSNs decreased in quantity using the LMA formula; and 38 NSNs increased in quantity using the LMA formula. The cost of the NOP items computed using the LMA formula increased by 2.96 million dollars over the PACAF computed NOP items and 3.64 million dollars more than DMAS computed NOP items, as shown in Figure 5 below.
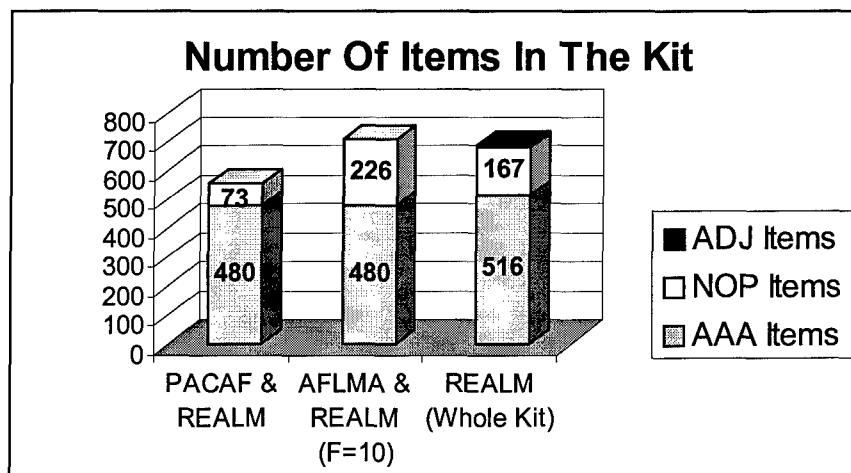
Number Of Items In The Kit

	ADJ Items	NOP Items	AAA Items
PACAF & REALM	73		480
AFLMA & REALM (F=10)	226		480
REALM (Whole Kit)	167		516

Figure 4. C-130 Kit Compositions

Kit Costs In Millions of Dollars

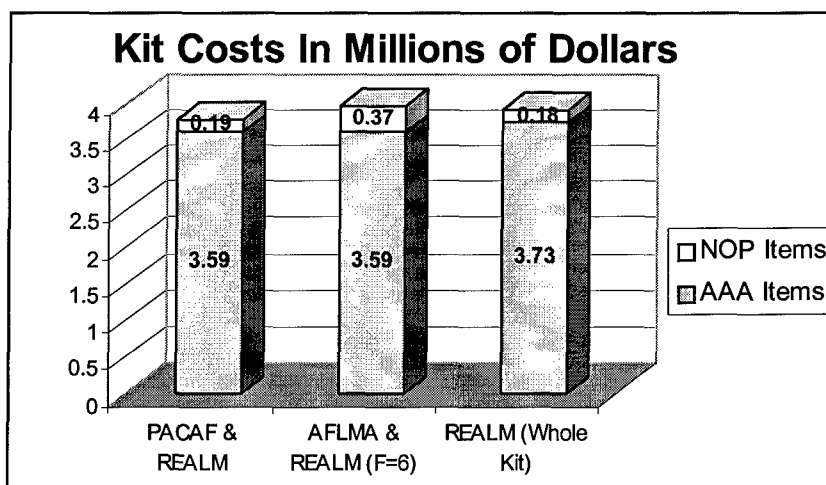|	NOP Items	AAA Items
PACAF & REALM	0.19	3.59
AFLMA & REALM (F=6)	0.37	3.59
REALM (Whole Kit)	0.18	3.73

Figure 5. C-130 Kit Costs

Summary

The D087 computed whole kits (with NOP items) were not significantly larger than the baseline (without NOP items) kits; therefore, calculating NOP items with the non-NOP items did not cause the RSP to grow significantly in size. The number of currently computed items (AAA/non-NOP) remained the same or increased slightly (breadth and depth) when NOP items were included in the kit computation using D087 demand rates. Non-NOP items were not displaced by the NOP items when they were computed together as a whole kit. This shows **REALM/ASM whole-kit computations including NOP items are feasible.**

COST BENEFIT ANALYSIS

In order to determine the merits of computing NOP item requirements for the three kit computation alternatives, kit performance was chosen as our primary measure of merit. Aircraft

10

Availability (AA) and kit cost were chosen as the metrics, since this is how the AF currently measures kit performance. In order to do this, we took the computed kit from each approach and completed a DMAS assessment in terms of sorties flown and aircraft availability. DMAS was used because it has the same ASM logic embedded in it as REALM and is the AF accepted method for assessing RSPs. We did this for the two kits examined in the previous "Results" section, one fighter (F-16) and one larger aircraft (C-130). Since sample kit computations showed DMAS/ASM whole-kit computations for NOP items to be feasible, these kit results/quantities will be used in the cost benefit analysis of the three methods.

F-16 KIT COMPUTATION COMPARISONS

F-16	REALM/DMAS	PACAF	LMA F=6	LMA F=2.5	LMA F=5	LMA F=7
Total Items (depth)	130	123	148	106	135	159
Kit Cost	$3.90M	$3.78M	$3.96M	$3.66M	$3.86M	$4.06M
10 Day (DSO=86.46%)	86.67%	85.67%	86.46%	83.83%	86.33%	86.46%
30 Day (DSO=63%)	73.04%	71.29%	72.42%	67.42%	71.75%	72.58%

Table III. F-16 Aircraft Availability Versus Kit Cost

Table III above shows the results, in terms of expected aircraft availability and kit cost, for each of the computation methods for an F-16 RSP. The "REALM/DMAS" column shows the results of computing the entire kit using DMAS. The "PACAF" column shows the results of using DMAS computed results for AAA items and the PACAF formulas to compute NOP items. The "LMA F=6" column shows the results of using DMAS to compute the AAA items for the kit and the AFLMA formula to compute the NOP item quantities. Table III shows that meeting the 10 day surge aircraft available rate is the constraining factor for the computation methods. The whole-kit DMAS computation and the LMA formula kit computation of NOP items both met the 10 day DSO. However, the AFLMA formula computed kit had 18 more total items and cost $60,000 more than the DMAS whole-kit computation. The PACAF formulas computed kit performed slightly below the required 10 day DSO. Figure 6 below graphically shows the F-16 computed kit performance results by computation method.
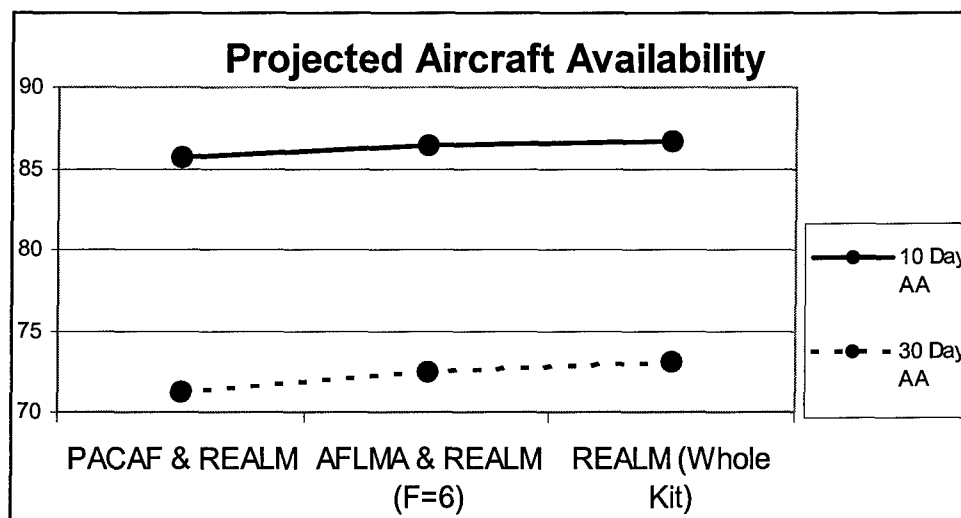
Figure 6. F-16 Kit Performance By Computation Method

C-130 KIT COMPUTATION COMPARISONS

C-130	REALM/DMAS	PACAF	LMA F=10	LMA F=2.5	LMA F=7	LMA F=8
Total Items (depth)	687	553	706	501	609	644
Kit Cost	$12.70M	$12.62M	$15.58M	$10.96M	$12.74M	$14.11M
30 Day (DSO=83%)	83.13%	76.44%	82.56%	67.38%	80.25%	81.56%

Table IV. C-130 Aircraft Availability Versus Kit Cost

Table IV above shows the results of each computation method, in terms of expected aircraft availability and kit cost, for a C-130 RSP. As with the F-16 results, the "REALM/DMAS" column shows the results of computing the entire kit using DMAS. The "PACAF" column shows the results of using DMAS computed results for AAA items and the PACAF formulas to compute NOP items. The "LMA F=10" column shows the results of using DMAS to compute the AAA items for the kit and the AFLMA formula to compute the NOP item quantities. The C-130 has no surge availability rate like the F-16, but the kit size for the C-130 is notably larger in terms of cost and number of items needed to meet the DSO. Of the three computation methods, only the whole-kit DMAS computation met the 30 day DSO. The PACAF formulas computed a kit which performed well below the required DSO (greater than 6 % lower) with nearly the same cost as the DMAS computed kit. Using an F-factor of 10, the kit using the LMA formula fell just below the required DSO of 83% and cost 2.88 million dollars more than the DMAS computed kit. Figure 7 below shows the C-130 computed kit performance results by computation method.
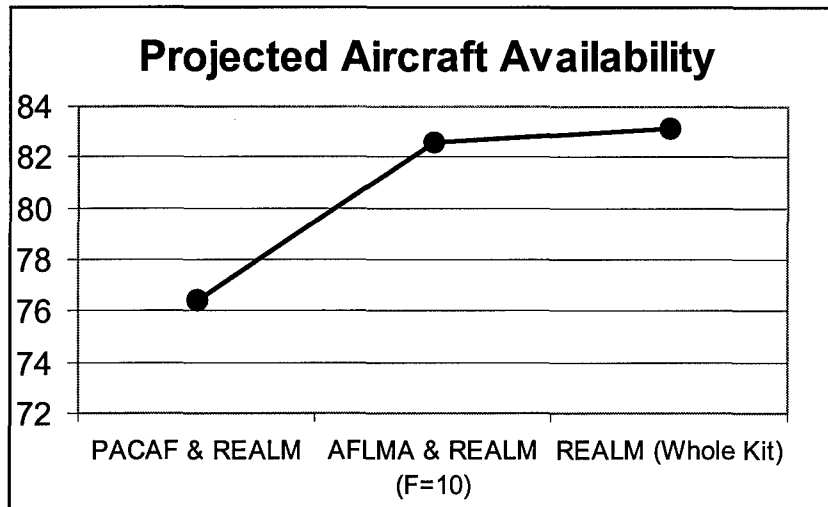
Projected Aircraft Availability

Figure 7. C-130 Kit Performance By Computation Method

REALM/ASM
The tables and figures above show the **cost-based marginal analysis approach used in DMAS/ASM provides more aircraft availability at less cost**. When comparing similar F-16 kit costs for the three methods (the first three columns of Table III), DMAS/ASM provides over one percent greater expected availability than either the PACAF or AFLMA computations. The PACAF computation fails to meet the necessary Day 10 DSO, and a minimum of F=6 must be used for the AFLMA computation to meet the DSO. This causes the AFLMA kit cost to be greater than the DMAS/ASM kit cost. A comparison of the larger computed C-130 kits shows the same trends with greater differences between the computations. Using marginal analysis, DMAS/ASM yielded 6.7 percent greater availability than the PACAF formulas, and the AFLMA computed kit would cost considerably more, as it requires an F-value of greater than 10 to meet the required Day 30 DSO.

AFLMA FORMULA COMPUTATIONS
Greater availability resulted from the AFLMA formula computed kit than from the PACAF spreadsheet computed kit, but both cost more and/or yield lower AA than the DMAS/ASM computed kits. The PACAF spreadsheet formula does not yield the required AA (DSO) and has no capability to be adjusted to yield the required DSO. The variable F-factor shown in the tables above, associated with the AFLMA formula computation results, is a multiplier of the standard deviation of the computed requirement. This F-factor determines the quantity of safety level to be included, and can be adjusted to provide the necessary availability. Determining the lowest F-factor needed to yield the minimum DSO can only be achieved through trial and error. The results also show that in order to obtain comparable performance to DMAS/ASM for different kits using the AFLMA formula, different F-factors must be used for different weapon systems. No single AF-wide F-factor would provide satisfactory performance.

The F-factor provides an impediment to implementing the AFLMA formula for AF-wide use. Some organizations would have to compute and assess a sample of RSPs to develop a suitable F-factor for every weapon system. There is no guarantee that F-factors will remain stable by

13

weapon system year to year, so the analysis may have to be repeated annually. Therefore, our formulas, although theoretically superior to the PACAF spreadsheet formulas, may not be feasible for practical application..

SENSITIVITY ANALYSIS

In this section we document our analysis using D041 demand rates (see Appendix E for tables of the results). Note, up until now we used demand rates included in D087, consisting mainly of backed-in demand rates from a quantity either provided by the MAJCOM or computed using the PACAF spreadsheet. To use marginal analysis (i.e. ASM) to compute NOP quantities, we propose MAJCOMs provide failure data (ex. demands per sortie or rounds fired per sortie) which can be converted into demands per flying hour. The following information shows our attempt to convert failure rates using D041 failure data.

a. We substituted the D041 demand rates for the D087 demand rates for the NOP/ADJ items. We converted these D041 demand rates from sortie-based, rounds fired, operating hours, etc. using the formulas in figure 1.

b. Since the kits were dominated by gun parts using D041 demand rates, another computation was performed with the D041 data, omitting gun parts. The last column of the tables in Appendix E show how many gun related line items and units were excluded from the authorized kit during this computation.

c. One final computation was completed for the E-3 because 19 of the 36 NOP items in the current kit had 0 demand rates in D041, which makes comparisons between the D087 and D041 kit difficult. Using the D087 rates, this computation excluded the 19 items with D041 demand rates of zero.

The D041 demand rate computations resulted in kits dominated by gun parts. One kit was over eight-times larger overall with gun NOPs included in the kit computation. This may be a result of invalid D041 gun data or unrealistic gun usage rates (an estimated/assumed 80 percent of rounds capacity usage per sortie based on data from HQ USAF ILM) used to convert the demand rates. We suspect the assumption of rounds expended per sortie contributed more to these results. When the computations were done again without gun parts, the kits were substantially smaller in size, but remained significantly larger than the D087 demand rate computed kits.

This points out the second significant issue concerning NOP computations. We showed it is feasible , in fact beneficial, to compute NOP quantities using marginal analysis. There is still the issue of what failure rate to use for NOP items. Our sensitivity analysis shows the computation is sensitive to demand rates. So, it is important to use accurate demand rates and to compare the computation results to some other reasonable measure, the previous year NOP quantity for example.

Another potential problem with using ASM to compute NOPs is that the model assumes a certain variability in the demand rate forecast, and some NOP items may not meet those variability assumptions. For example, tires need changing per some number of landings (sorties). So demand for tires is almost deterministic (very little variability). Marginal analysis may compute too high a level for tires because it assumes demand is more variable than it is. Also if tires are relatively inexpensive, marginal analysis generally computes higher levels for inexpensive items.

The bottom line is even if marginal analysis computes NOP quantities, human judgement will still be needed to verify and, if necessary, adjust the resulting NOP quantity. REALM/ASM computed RSP NOP quantities will need to be compared to the previously computed NOP quantities to ensure inaccurate data has not corrupted the computations. Previous RSP NOP quantities should be file maintained as a fallback for unreasonable REALM computed quantities. The current requirement to review all quantity changes from year to year also must be maintained to ensure proper NOP quantities.

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CHAPTER 3

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

1. Using the current D087 demand rates, whole kit computations in REALM are feasible.
   - Non-NOP items (AAA) are not displaced by the NOP items when they are computed together using D087 demand rates.
   - The overall size of the computed RSP (total parts) does not significantly increase when NOP items are included in the REALM kit computation.
2. The kit computations are sensitive to demand data. Inaccuracies in D041 demand data or demand rate conversion assumptions can have significant impact on the breadth and depth of the computed kit.
3. The cost-based marginal analysis approach used in REALM/ASM provides more aircraft availability at less cost.
   - RSPs with AFLMA formula computed NOP items provide similar or greater aircraft availability for comparable cost RSPs with PACAF spreadsheet computed NOP items, but both methods cost more and yield lower AA than DMAS/ASM computed kits.
4. Obtaining proper demand data for RSP NOP item computations continues to be an issue and is not resolved in this study. Human monitoring and intervention continues to be necessary for RSP NOP item demand data and requirements calculations. Initial NOP quantities or flying hour demand rates still must be provided by the MAJCOM.

RECOMMENDATIONS

1. Compute entire RSPs (including all NOP items) in REALM (D087).
   - Review NOP demand rates before REALM/ASM RSP computations to ensure accuracy. MAJCOM representatives should collect and bring appropriate NOP demand data to the annual RSP reviews to fill data gaps in D087 data.
2. Compare the REALM/ASM computed RSP NOP quantities to the previously maintained NOP quantities to ensure inaccurate data has not corrupted the computations.
   - Previous RSP NOP quantities should be file maintained as a fallback for unreasonable REALM computed quantities. (This is only an interim measure to be used until computation methods and results are verified as appropriate.)
   - All NOP quantity changes from year to year should be reviewed

DISTRIBUTION: Refer to attached Standard Form 298.

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APPENDIX A

AFLMA NOP FORMULA

Q = Wartime Demands - Canns. + SLQ

Wartime Demands = NRTS Pipeline + Repair Cycle Pipeline (including set-up time)

Canns. = [(1-DSO) x PAA x QPA x App Fract] x C

SLQ = SQRT(Wartime Demands) x F

Figure 8. Proposed NOP Formula (Basic)

Q = NRTS {$\frac{demands}{sortie}$ x PAA x QPA x App Fract x [(SSR x surge days) + (ISR x interim days)]}

+ (1-NRTS) {$\frac{demands}{sortie}$ x PAA x QPA x App Fract x [SSR x min. of {surge days, (setup days + RCT)}

+ ISR x max. of {(setup days + RCT - surge days), 0}]}

- [(1-DSO) x PAA x QPA x App Fract] x *C

+ SQRT(Wartime Demands) x **F

Figure 9. Proposed NOP Formula (Complete)

NRTS - Not Repairable This Station Rate   SSR - Surge Sortie Rate
PAA - Primary Assigned Aircraft   ISR - Interim Sortie Rate
RCT - Repair Cycle Time   DSO - Direct Support Objective %
QPA - Quantity Per Aircraft   SLQ - Safety Level Quantity

*C = Cannibalization Flag (In this analysis 0 – non cann. item, 1 – cann. item)
**F = Safety Level Factor

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APPENDIX B

CURRENT NOP FORMULAS

SORTIE NOP

$$Q_{sortie} = \frac{\text{Wartime Sorties}}{\text{MSBD}} - \text{Canns.} \qquad \{\text{where} \ \ MSBD = \frac{\text{Peacetime Sorties}}{\text{Rep. Gens.}} * QPA\}$$

$$Q_{sortie} = \frac{[\text{Wartime Sorties} * \text{Rep. Gens}]}{[\text{Peacetime Sorties} * QPA]} - \frac{(1-DSO) * PAA}{2}$$

GUN NOP

$$Q_{gun} = \frac{\text{Wartime Sorties} * \text{Expenditure Per Sortie Factor (per thousand)}}{\text{MRBD}} - \text{Canns.}$$

$$\{\text{where} \ \ MRBD = \frac{(\text{Peacetime Rounds Fired/1000})}{\text{Rep. Gens.}} * QPA\}$$

$$Q_{gun} = \frac{[\text{Wartime Sorties} * \text{Exp. Per Sortie Factor (per thousand)} * \text{Rep. Gens}]}{[\text{Peacetime Rounds Fired/1000} * QPA]} - \frac{(1-DSO) * PAA}{2}$$

TIRE NOP

$$Q_{tire} = \frac{\text{Wartime Sorties}}{\text{Landings Per Tire}} * QPA$$

WHEEL NOP

$$Q_{wheel} = \frac{\text{Surge Sortie Rate} * \text{Number of Surge Days} * PAA}{\text{Landings Per Tire}} * QPA$$

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APPENDIX C

DATA SOURCES

The biggest hurdle to overcome when trying to compute the proper kit quantity for NOP items is obtaining good demand data. There are five primary sources of this data:

- D087
- D041
- MAJCOM
- Base/Unit
- War Mobilization Plan (WMP) 5

The D087 NOP demand rates are 'backed in' using a predetermined NOP quantity, and D041 demand rates are calculated based on world-wide demands. Raw data can be obtained from MAJCOMs or individual bases on sorties flown. Rounds fired, however, can only be obtained from the base. Rounds fired data is entered into CAMS, but is not rolled up to the parent command. These four data sources can provide limited peacetime data of varying accuracy. Cycles or operating time is not tracked by any of our current systems, so no data is available for this category of NOP items. Finally, the WMP 5 contains data on wartime requirements.

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APPENDIX D
COMPARISON OF PACAF, LMA, AND ASM NOP COMPUTATIONS

B-52	AAA		NOP		ADJ		TOTAL	
	NSN's/Items	Cost	NSN's/Items	Cost	NSN's/Items	Cost	NSN's/Items	Cost
D087-AAA	172/781	$44.0M	n/a	n/a	n/a	n/a	172/781	$44.0M
PACAF	172/781	$44.0M	4/16	$86K	0	0	176/797	$44.1M
LMA	172/781	$44.0M	0	0	0	0	172/781	$44.0M
DO87-ALL	172/781	$44.0M	4/40	$363K	6/49	$253K	182/870	$44.6M

Table V. B-52 Kit Composition By Computation Method

F-15C	AAA		NOP		ADJ		TOTAL	
	NSN's/Items	Cost	NSN's/Items	Cost	NSN's/Items	Cost	NSN's/Items	Cost
D087-AAA	156/432	$14.2M	n/a	n/a	n/a	n/a	156/432	$14.2M
PACAF	156/432	$14.2M	1/4	$2K	0	0	157/436	$14.2M
LMA	156/432	$14.2M	1/43	$19K	0	0	157/475	$14.2M
DO87-ALL	158/435	$14.3M	5/84	$263K	0	0	163/519	$14.6M

Table VI. F-15C Kit Composition By Computation Method

A-10A	AAA		NOP		ADJ		TOTAL	
	NSN's/Items	Cost	NSN's/Items	Cost	NSN's/Items	Cost	NSN's/Items	Cost
D087-AAA	3/3	$39K	n/a	n/a	n/a	n/a	3/3	$39K
PACAF	3/3	$39K	20/100	$622K	0	0	23/103	$661K
LMA	3/3	$39K	6/35	$113K	0	0	9/38	$152K
DO87-ALL	5/5	$114K	12/56	$122K	0	0	17/61	$237K

Table VII. A-10A Kit Composition By Computation Method

F-15E	AAA		NOP		ADJ		TOTAL	
	NSN's/Items	Cost	NSN's/Items	Cost	NSN's/Items	Cost	NSN's/Items	Cost
D087-AAA	31/315	$2.7M	n/a	n/a	n/a	n/a	31/315	$2.7M
PACAF	31/315	$2.7M	4/26	$325K	0	0	35/341	$3.0M
LMA	31/315	$2.7M	0	0	0	0	31/315	$2.7M
DO87-ALL	31/316	$2.8M	2/21	$147K	0	0	33/337	$2.9M

Table VIII. F-15E Kit Composition By Computation Method

E-3B	AAA		NOP		ADJ		TOTAL	
	NSN's/Items	Cost	NSN's/Items	Cost	NSN's/Items	Cost	NSN's/Items	Cost
D087-AAA	295/896	$42.3M	n/a	n/a	n/a	n/a	295/896	$42.3M
PACAF	295/896	$42.3M	30/51	$7.8M	0	0	325/947	$50.1M
LMA	295/896	$42.3M	29/56	$7.7M	0	0	324/952	$50.0M
DO87-ALL	295/952	$46.1M	36/143	$11.8M	0	0	331/1095	$57.9M

Table IX. E-3B Kit Composition By Computation Method

APPENDIX E

D041 DEMAND RATE COMPUTATIONS

	Baseline Kit - AAA items only	AAA & NOP Kit	AAA & NOP Kit - w/o 6 Gun parts
Demand Rate Source	D087	**D041**	**D041**
TOTAL (NSNs/Total)	36/91	10/2221	55/277
NOP (NSNs/Total)	n/a	8/2213	12/228
AAA (NSNs/Total)	36/91	2/8	43/159
COST (in millions)	3.6	29.0	7.9

Table X. F-16C Sample Kit Computations

	Baseline Kit - AAA items only	AAA & NOP Kit	D041 w/o 14 Gun parts
Demand Rate Source	D087	**D041**	**D041**
TOTAL (NSNs/Total)	156/432	386/3477	372/1490
NOP (NSNs/Total)	n/a	38/2252	24/274
AAA (NSNs/Total)	156/432	348/1225	348/1216
COST (in millions)	14.2	69.7	51.8

Table XI. F-15C Sample Kit Computations

	Baseline Kit - AAA items only	AAA & NOP Kit	D041 w/o 12 Gun parts
Demand Rate Source	D087	**D041**	**D041**
TOTAL (NSNs/Total)	3/3	67/2001	55/356
NOP (NSNs/Total)	n/a	53/1931	41/289
AAA (NSNs/Total)	3/3	14/70	14/67
COST (in millions)	0.0	42.2	6.4

Table XII. A-10A Sample Kit Computations

	Baseline Kit - AAA items only	AAA & NOP Kit	D041 w/o 9 Gun parts
Demand Rate Source	D087	**D041**	**D041**
TOTAL (NSNs/Total)	31/315	279/3046	269/1258
NOP (NSNs/Total)	n/a	34/2022	25/233
AAA (NSNs/Total)	31/315	245/1024	244/1025
COST (in millions)	2.7	54.5	32.6

Table XIII. F-15E Sample Kit Computations

	Baseline Kit - AAA items only	AAA & NOP Kit
Demand Rate Source	D087	**D041**
TOTAL (NSNs/Total)	172/781	181/955
NOP (NSNs/Total)	n/a	9/174
AAA (NSNs/Total)	172/781	172/781
COST (in millions)	44.0	44.7

Table XIV. B-52 Sample Kit Computations

	Baseline Kit - AAA items only	AAA & NOP Kit
Demand Rate Source	D087	**D041**
TOTAL (NSNs/Total)	121/480	177/781
NOP (NSNs/Total)	n/a	50/225
AAA (NSNs/Total)	121/480	127/556
COST (in millions)	10.5	18.0

Table XV. C-130 Sample Kit Computations

	Baseline Kit - AAA items only	** AAA & NOP Kit w/o 19 items	AAA & NOP Kit
Demand Rate Source	D087	D087	**D041**
TOTAL (NSNs/Total)	295/896	312/999	312/1042
NOP (NSNs/Total)	n/a	17/98	17/134
AAA (NSNs/Total)	295/896	295/901	295/908
COST (in millions)	42.3	46.9	47.9

Table XVI. E-3 Sample Kit Computations

** 19 of the original 36 NOP items with 0 demand rates in D041 were taken out

APPENDIX F

ACRONYMS

AFAA	Air Force Audit Agency
AFLMA	Air Force Logistics Management Agency
AFMC	Air Force Materiel Command
AFSWPWG	Air Force Supply Wartime Policy Working Group
ASM	Aircraft Sustainability Module
CAMS	Core Automated Maintenance System
DMAS	Dyna-METRIC Microcomputer Analysis System
DSO	Direct Support Objective
HQ	Headquarters
ISR	Interim Sortie Rate
LMI	Logistics Management Institute
MAJCOM	Major Command
NOP	Non-Optimized
NRTS	Not Reparable This Station
PAA	Primary Authorized Aircraft
PACAF	Pacific Air Force
QPA	Quantity Per Aircraft
REALM	Requirements/Execution Availability Logistics Module
RCT	Repair Cycle Time
RSP	Readiness Spares Package
SAM	Sustainability Assessment Module
SLQ	Safety Level Quantity
SSR	Surge Sortie Rate
WMP	War and Mobilization Plan
WSM	Weapon System Manager
WSMIS	Weapon System Management Information System

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APPENDIX G

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